Chapter 6. Benthic Community Density and Composition

The Benthic Monitoring Program is designed to document the distribution, diversity and abundance of benthic (bottom dwelling) organisms and substrate composition in the Sacramento-San Joaquin Delta and Suisun and San Pablo bays. The benthic community of the Delta and these westerly bays is a diverse assemblage of organisms, which include fungi, ciliates, worms, crustaceans, insects and molluscs. The program focuses on monitoring the benthic macrofauna (organisms larger than 0.5 mm) (DWR 2001). Substrate composition is monitored to evaluate changes in benthic fauna in relation to the substrate. Hydrozoology, a private laboratory under contract with the Department of Water Resources, identified and enumerated organisms in the macrofaunal samples. Particle size analysis and dry weight measurements for each sediment sample are performed at the DWR Soils and Concrete Laboratory. Methods of analysis for each the independent laboratories are explained below.

Methods

We sample benthic macroinvertebrates using the methods described in *Standard Methods for the Examination of Water and Wastewater* (APHA 1998). The formalin preservative used to fix the sample in the field is poured off in the laboratory and the sample is washed on a United States standard #30 mesh screen. Organisms are then placed in 70% ethyl alcohol for identification and enumeration. A stereoscopic dissecting microscope (70-120x) is used to identify most organisms. When taxonomic features are too small for identification under the dissecting scope, the organism is permanently mounted on a slide and examined under a compound microscope. If more than four hours of sorting are required, and a sample contains many organisms but few species, a one-fourth sub-sample is chosen at random. The sub-sample is sorted and the results are multiplied by four to represent the total sample. The remainder of the sample is inspected to make sure no taxa are overlooked. Individual species counts are multiplied by 19 to convert the number of organisms per grab sample to organisms per square meter.

Substrate is analyzed for particle size according to the American Society of Testing and Materials Protocol D422 (ASTM a. 2000). Particles are sorted into the following categories: >2350 µm, >1180 µm, >600 µm, >300 µm, >100 µm and >75 µm. Organic content of the sediment is determined by taking a sub-sample and using the American Society of Testing and Materials Protocol D2974, Method C (ASTM b. 2000). For this method an ash free dry weight of the sample is used to determine the organic content.

The ten EMP benthic monitoring stations in the upper San Francisco Estuary represent diverse salinity and substrate conditions. Figure 6-1 shows the location of each station and Table 6-1 summarizes latitude and longitude, salinity range, substrate composition, and the four most numerically dominant species for each station. Table 6-2 lists the new species found in the upper San Francisco Estuary from 1997-2000.

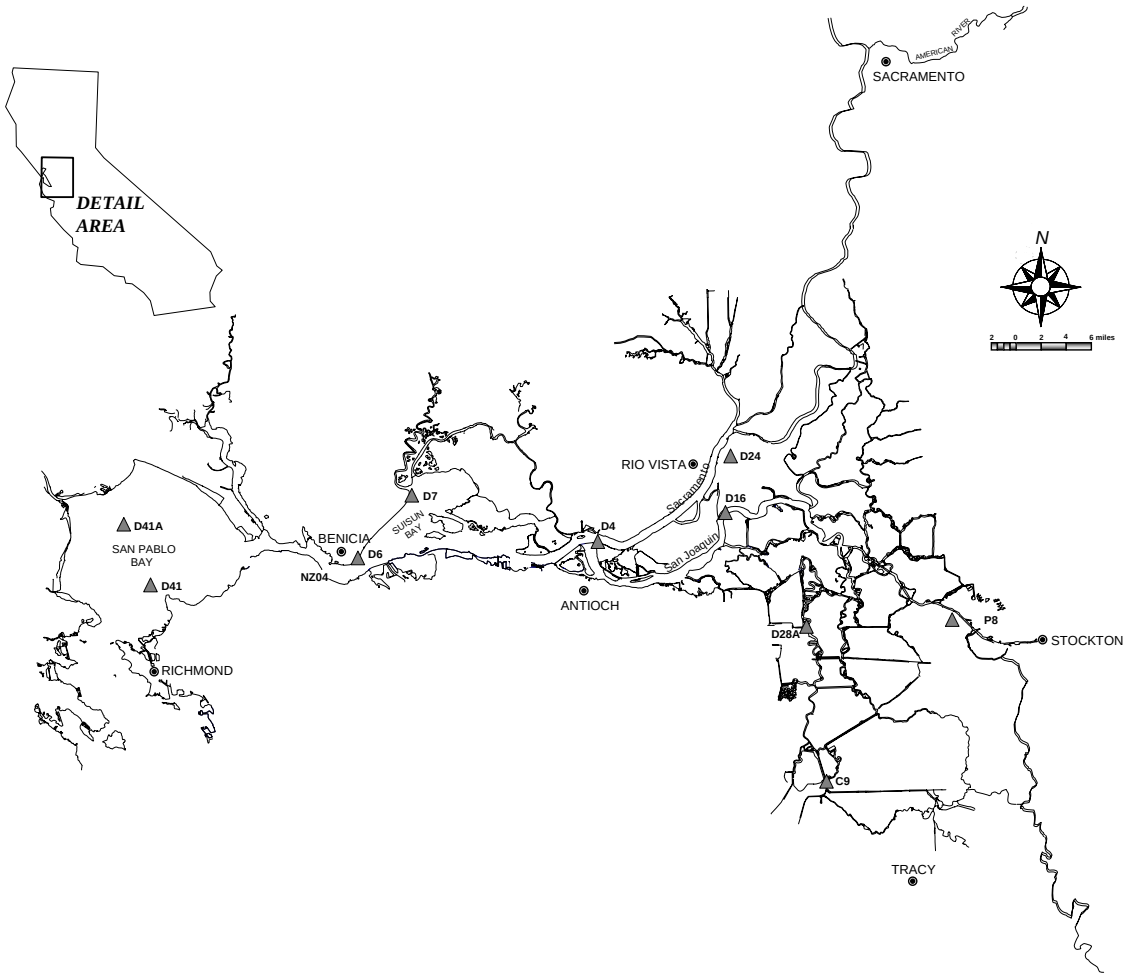


Figure 6-1 Map of benthic monitoring stations

Table 6-1 Macrobenthic monitoring station characteristics

Station Region	Latitude Longitude	Substrate Composition	Approx. Salinity Range 1997-2000 (uS/cm)	Genus Species	Abbreviation Used For Plots
C9 Delta-Old River	37° 49' 50" 121° 33' 09"	Consistent. Over 90% sand.	200-800	*Aulodrilus limnobius*	*A. limnobius*
				Limnodrilus hoffmeisteri	*L. hoffmeisteri*
				Varichaetadrilus angustipenis	*V. angustipenis*
				Corophium stimpsoni	*C. stimpsoni*
P8 Delta San Joaquin River	37° 58' 42" 121° 22' 55"	Consistent. High sand content (60%).	175-750	*Ilyodrilus frantzi capillatus*	*I. frantzi*
				Limnodrilus hoffmeisteri	*L. hoffmeisteri*
				Varichaetadrilus angustipenis	*V. angustipenis*
				Corophium stimpsoni	*C. stimpsoni*
D28A Delta Old River	37° 58' 14" 121° 34' 19"	Mixed composition of sand and fines.	200-350	*Varichaetadrilus angustipenis*	*V. angustipenis*
				Manayunkia speciosa	*M. speciosa*
				Corophium stimpsoni	*C. stimpsoni*
				Corbicula fluminea	*C. fluminea*
D16 Delta San Joaquin River	38° 05' 50" 121° 40' 05"	Consistent. Mostly fines with some organic materials.	130-500	*Varichaetadrilus angustipenis*	*V. angustipenis*
				Corophium stimpsoni	*C. stimpsoni*
				Gammarus daiberi	*G. daiberi*
				Corbicula fluminea	*C. fluminea*
D24 Delta Sacramento River	38° 09' 27" 121° 41' 01"	Consistent. High sand content (80%).	200-1200	*Limnodrilus hoffmeisteri*	*L. hoffmeisteri*
				Varichaetadrilus angustipenis	*V. angustipenis*
				Corophium stimpsoni	*C. stimpsoni*
				Corbicula fluminea	*C. fluminea*
D4 Delta Sacramento River	38° 03' 45" 121° 49' 10"	Mixed composition of sand, fines, and organic materials.	130-8,000	*Varichaetadrilus angustipenis*	*V. angustipenis*
				Corophium spinicore	*C. spinicore*
				Corophium stimpsoni	*C. stimpsoni*
				Gammarus daiberi	*G. daiberi*
D6 Suisun Bay	38° 02' 40" 122° 07' 00"	Fairly equal mixture of sand and fines.	135-30,000	*Marenzelleria virdis*	*M. virdis*
				Balanus improvisus	*B. improvisus*
				Nippoleucon hinumensis	*N. hinumensis*
				Potamocorbula amurensis	*P. amurensis*
D7 Grizzly Bay	38° 07' 02" 122° 02' 19"	Consistent. Mostly fines with some organic materials.	200-20,000	*Marenzelleria virdis*	*M. virdis*
				Corophium alienense	*C. alienense*
				Corophium stimpsoni	*C. stimpsoni*
				Potamocorbula amurensis	*P. amurensis*
D4 San Pablo Bay	38° 01' 50" 122° 22' 15"	Consistent. High content of fine material (87%).	20,000-45,000	*Nippoleucon hinumensis*	*N. hinumensis*
				Ampelisca abdita	*A. abdita*
				Corophium acherusicum	*C. acherusicum*
				Potamocorbula amurensis	*P. amurensis*
D41A San Pablo Bay	38° 03' 75" 122° 24' 40"	Consistent. High content of fine material (90%).	30,000-44,000	*Heteromastus filiformis*	*H. filiformis*
				Nippoleucon hinumensis	*N. hinumensis*
				Ampelisca abdita	*A. abdita*
				Potamocorbula amurensis	*P. amurensis*

Table 6-2 New species, 1997-2000

Station Found	Date	Phylum	Genus and/or Species
C9	April 2002	Annelida	*Pristinella jenkinae*
C9	June 1998	Annelida	*Potamothrix sp.A*
C9	March 1997	Annelida	*Uncinais uncinata*
C9	May 1998	Annelida	*Specaria josinae*
D24	April 1999	Arthropoda	*Bezzia sp. A*
D24	December 1998	Arthropoda	*Gymnometriocnemus sp. A*
D24	February 1999	Arthropoda	*Microcylloepus sp. A*
D24	February 2000	Arthropoda	*Dubiraphia sp. A*
D24	February 2000	Arthropoda	*Tanytarsus sp. B*
D24	March 1997	Annelida	*Dervo nivea*
D24	March 1997	Arthropoda	*Polypedilum sp.B*
D24	March 1997	Arthropoda	*Chironominid pupa sp. A*
D24	March 2000	Arthropoda	*Psectrocladius sp. B*
D28A	April 1999	Annelida	*Kincaidiana freidris*
D4	January 1999	Arthropoda	*Caecidotea racovitzai*
D4	May 1997	Arthropoda	*Cricotopus sp. B*
D4	September 1998	Arthropoda	*Eriocheir sinensis*
D41	April 1997	Mollusca	*UNID Tellinid Sp. A*
D41	December 1998	Arthropoda	*Cancer productus*
D41	December 1999	Mollusca	*Clinocardium nuttallii*
D41	February 1997	Annelida	*Mediomastus californiesis*
D41	February 1998	Mollusca	*Musculium sp. A*
D41	February 2000	Nematoda	*Monochulus sp. A*
D41	July 1997	Annelida	*Anaitides groenlandica*
D41	July 2000	Platyhelminthes	*UNID Planariid sp. A*
D41	March 1997	Arthropoda	*Eudorella pacifica*
D41	March 1997	Arthropoda	*Ampelisca lobata*
D41	March 1997	Mollusca	*Siliqua lucida*
D41	March 2000	Nematoda	*UNID Nematode sp. A*
D41	May 1997	Mollusca	*Moldiolus rectus*
D41	May 2002	Annelida	*Scolepis sp. A*
D41	November 1999	Arthropoda	*Pygodelphys sp.A*
D41	November 1999	Annelida	*Polydora socialis*
D41	November 1999	Mollusca	*Facelinidae sp. A*
D41	October 1997	Annelida	*Tubificoides motei*
D41	October 1997	Annelida	*Armandia brevis*
D41	October 1997	Annelida	*Typosyllis sp. A*
D41	October 1999	Annelida	*Amaeana occidentalis*
D41	October 1999	Arthropoda	*Stenothoe valida*
D41	September 1999	Arthropoda	*Achelia nudiuscula*
D41	October 1999	Arthropoda	*Caprella sp. B*
D41A	February 1997	Arthropoda	*Holmsimysis macropsis*
D41A	May 1997	Cnidaria	*UNID Actinarian sp. A*
D41A	May 1997	Arthropoda	*Acanthomysis aspera*
D6	April 1997	Arthropoda	*Acanthomysis bowmani*
P8	April 1997	Arthropoda	*Sphaeromias sp. A*

Figures 6-3 through 6-7 exhibit the abundance of the four most dominant species at each station and Figures 6-8 through 6-12 present the corresponding sediment characteristics. Typically the four species represent 90 to 95% of the total organisms collected at each station. Data from all stations within a region were averaged to estimate regional abundance.

Results

All animals collected during 1997-2000 belonged to one of the following nine phyla:

- Cnidaria (hydras, sea anemones)
- Platyhelminthes (flatworms)
- Nemertea (ribbon worms)
- Nematoda (roundworms)
- Annelida (segmented worms)
- Arthropoda (aquatic insects, amphipods, isopods, shrimp, crabs, mites, etc.)
- Mollusca (clams, snails)
- Chordata (tunicates)
- Echinodermata (seastars)

Of the nine phyla identified, Annelida, Arthropoda and Mollusca constituted 99.4% of the organisms collected (Figure 6-2).

The Environmental Monitoring Program (EMP) maintains a database of 284 benthic organisms identified within the upper San Francisco Estuary. The benthic database is dynamic and is constantly undergoing peer review and being updated. When a new organism is found at any of the sampling stations, the organism is identified to the species taxonomic level when possible and added to the database. During the study period, 46 new organisms were added to the benthic species list. Table 6-2 provides a list of new species and the locations from which they were collected.

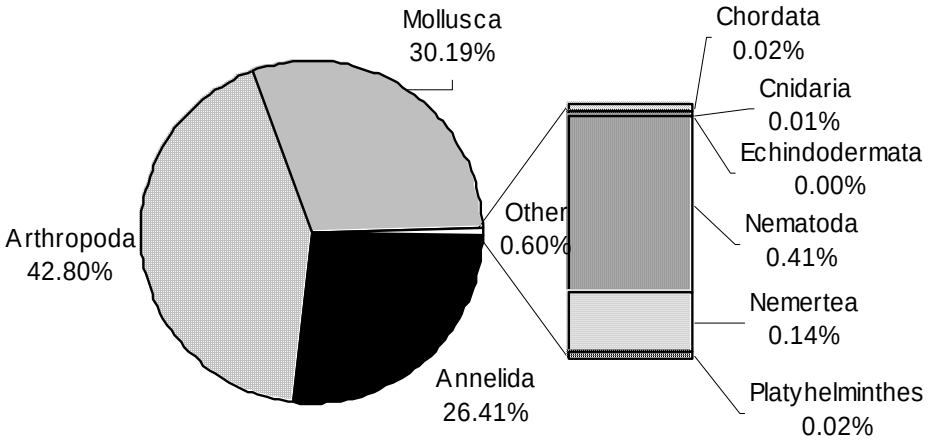


Figure 6-2 Total estuary contribution by phyla from 1997 through 2000

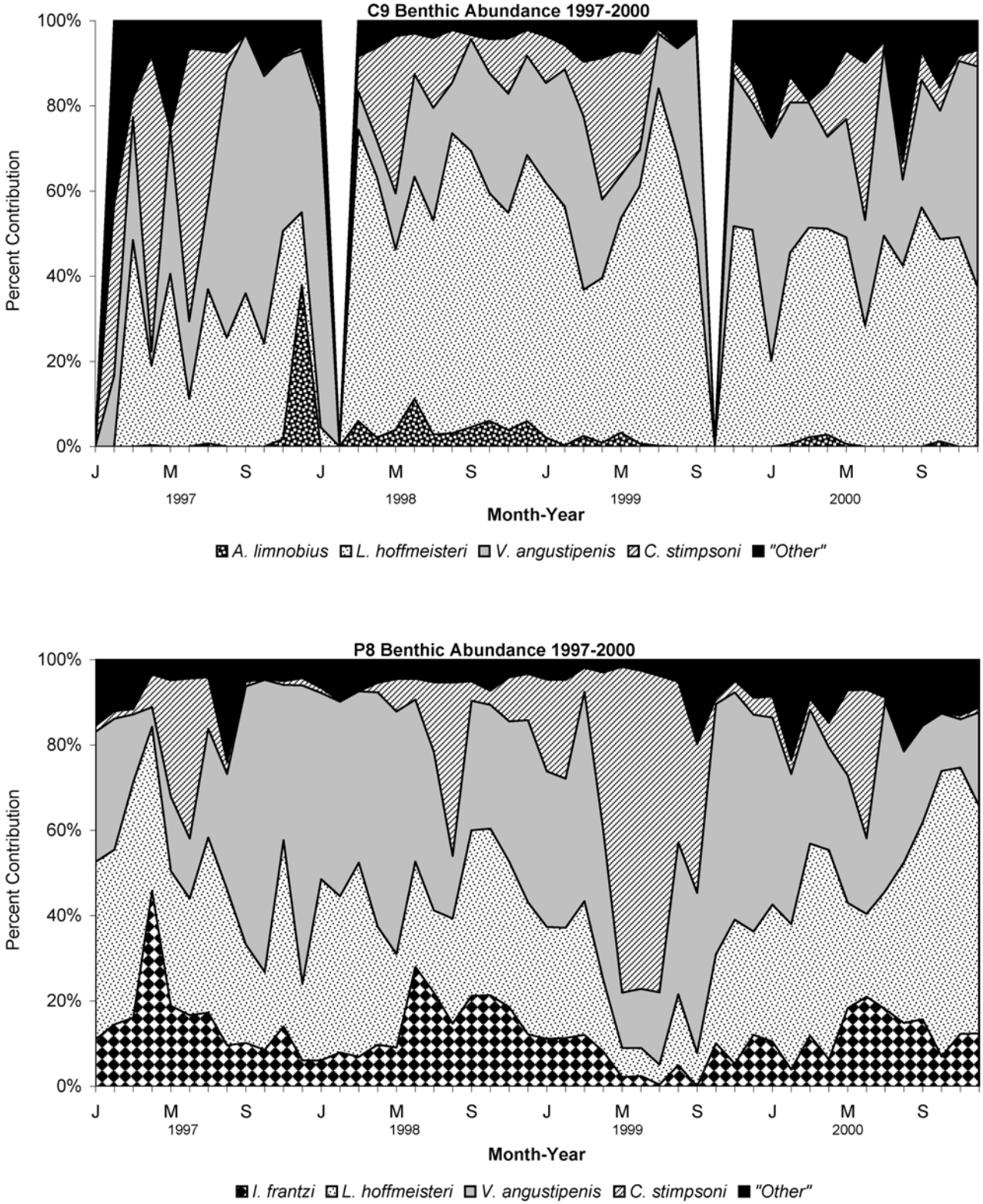
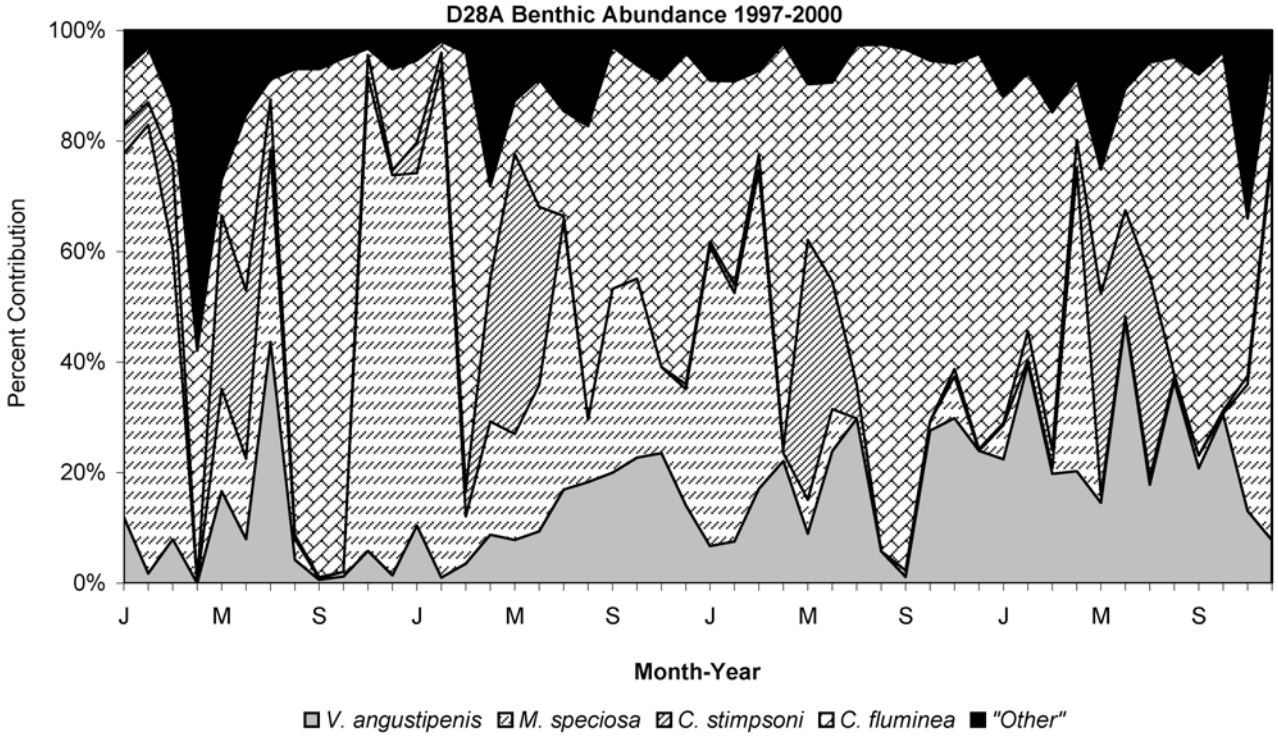


Figure 6-3 Percent abundance of macrobenthos at Stations C9 and P8, 1997-2000



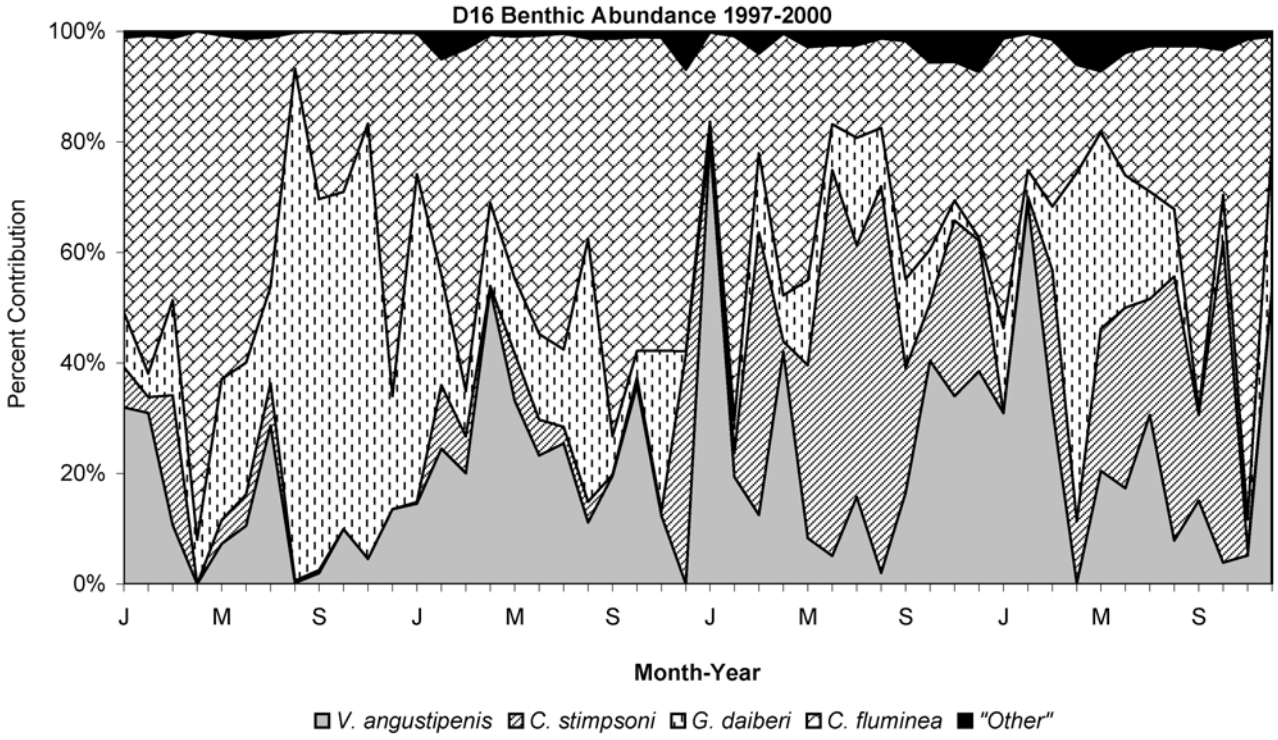


Figure 6-4 Percent abundance of macrobenthos at Stations D28A and D16, 1997-2000

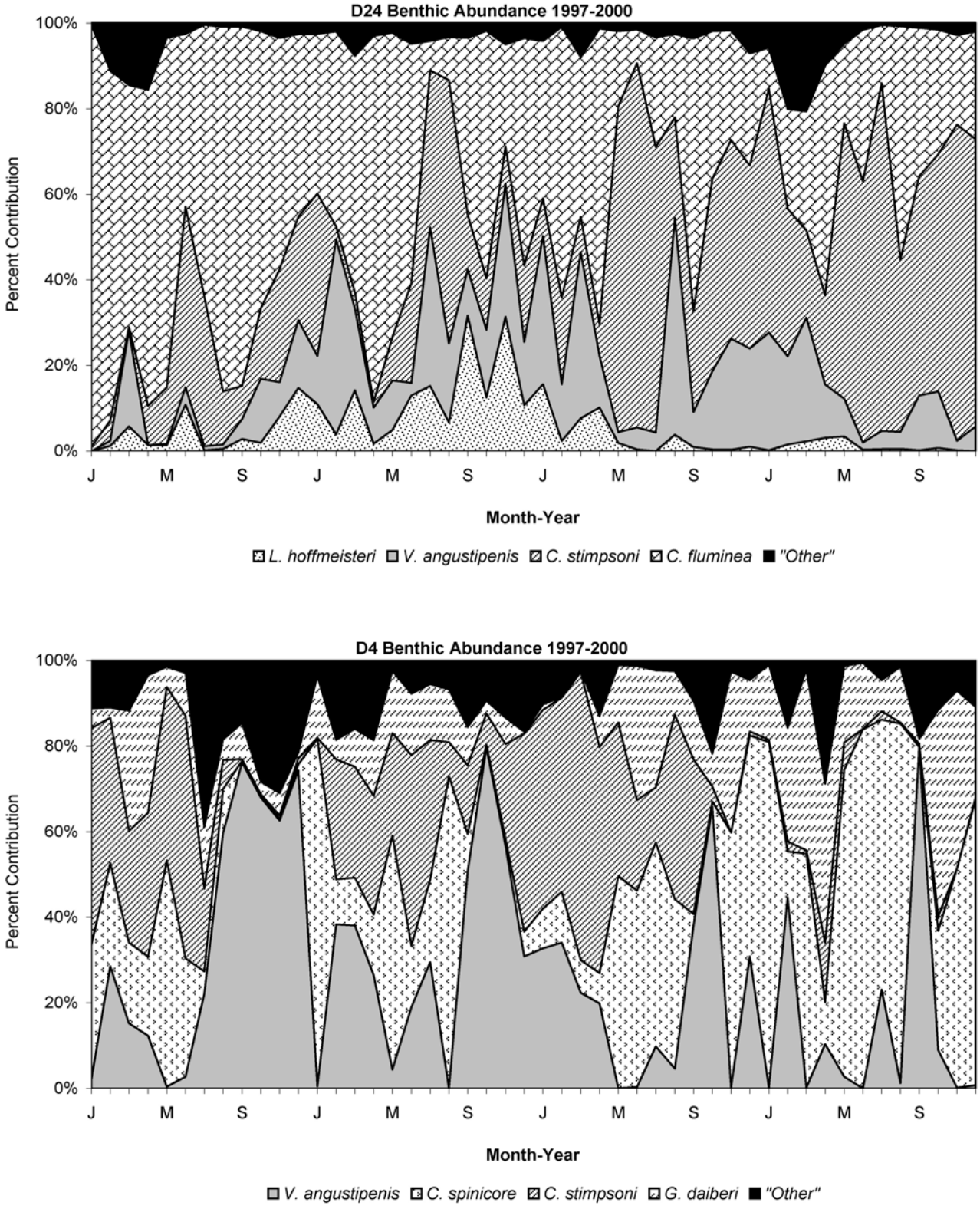
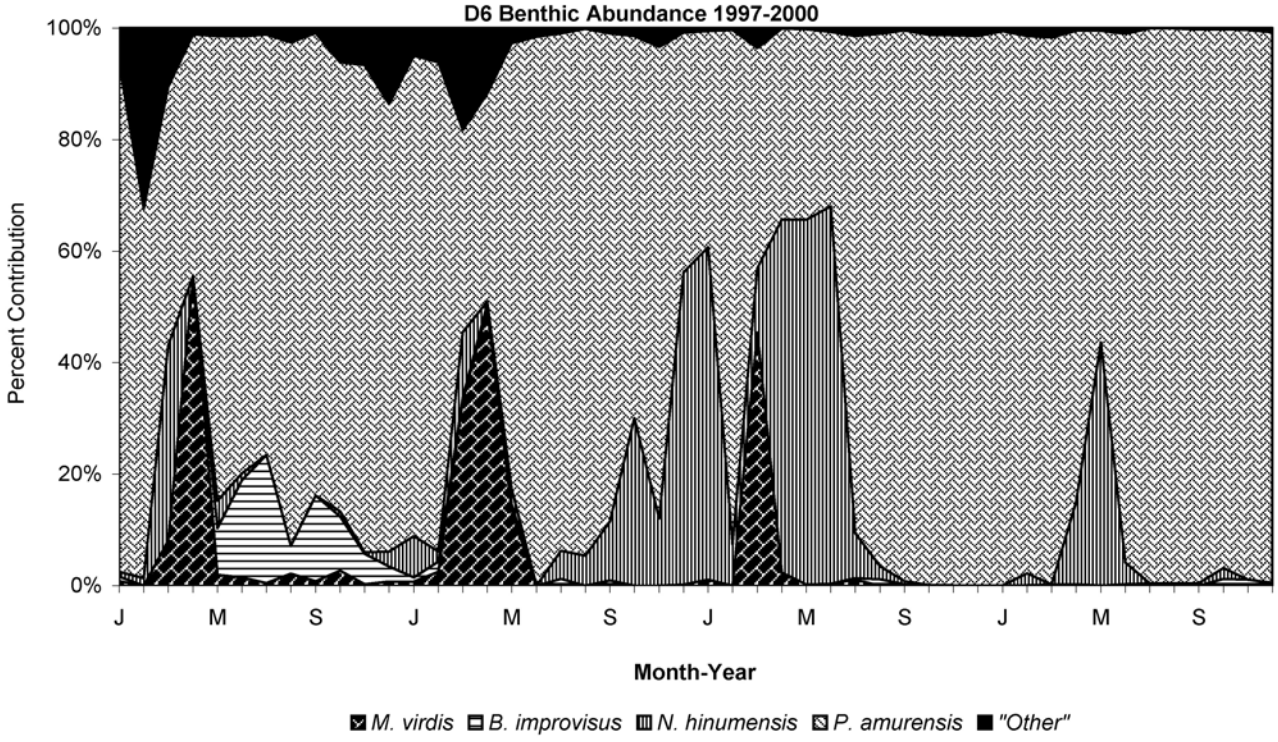


Figure 6-5 Percent abundance of macrobenthos at Stations D24 and D4, 1997-2000



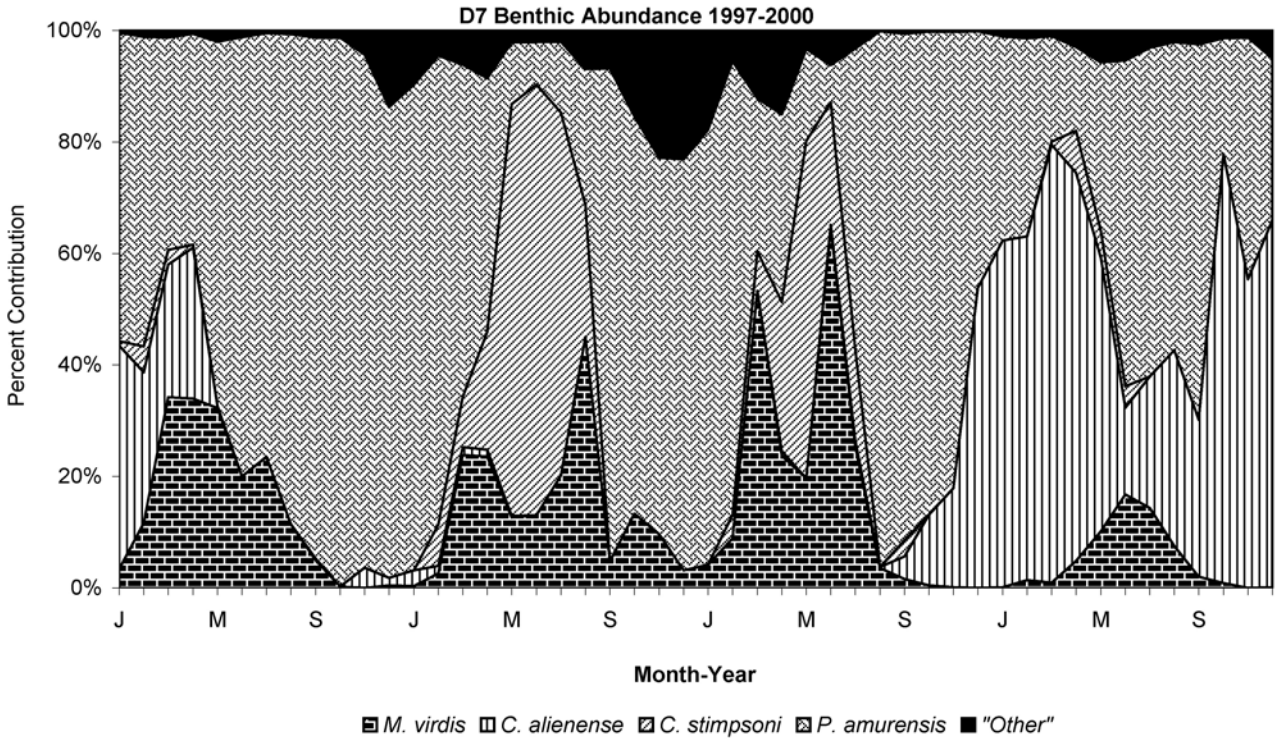
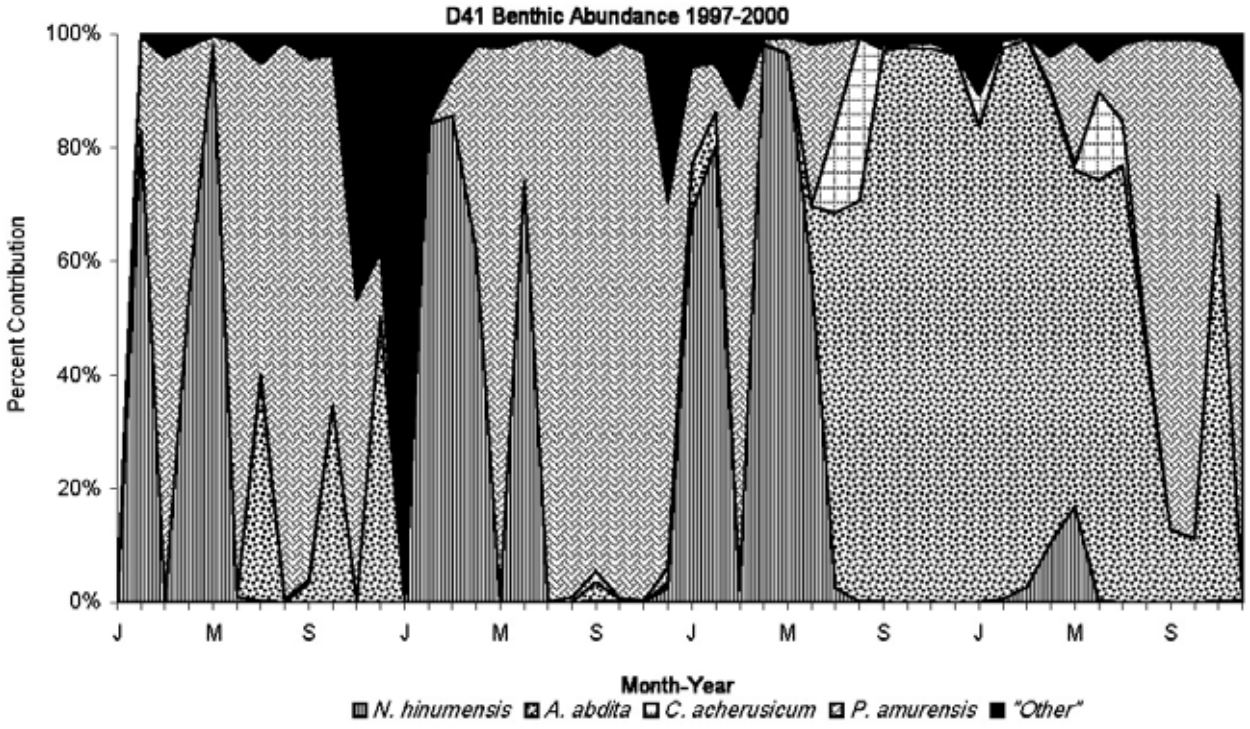


Figure 6-6 Percent abundance of macrobenthos at Stations D6 and D7, 1997-2000



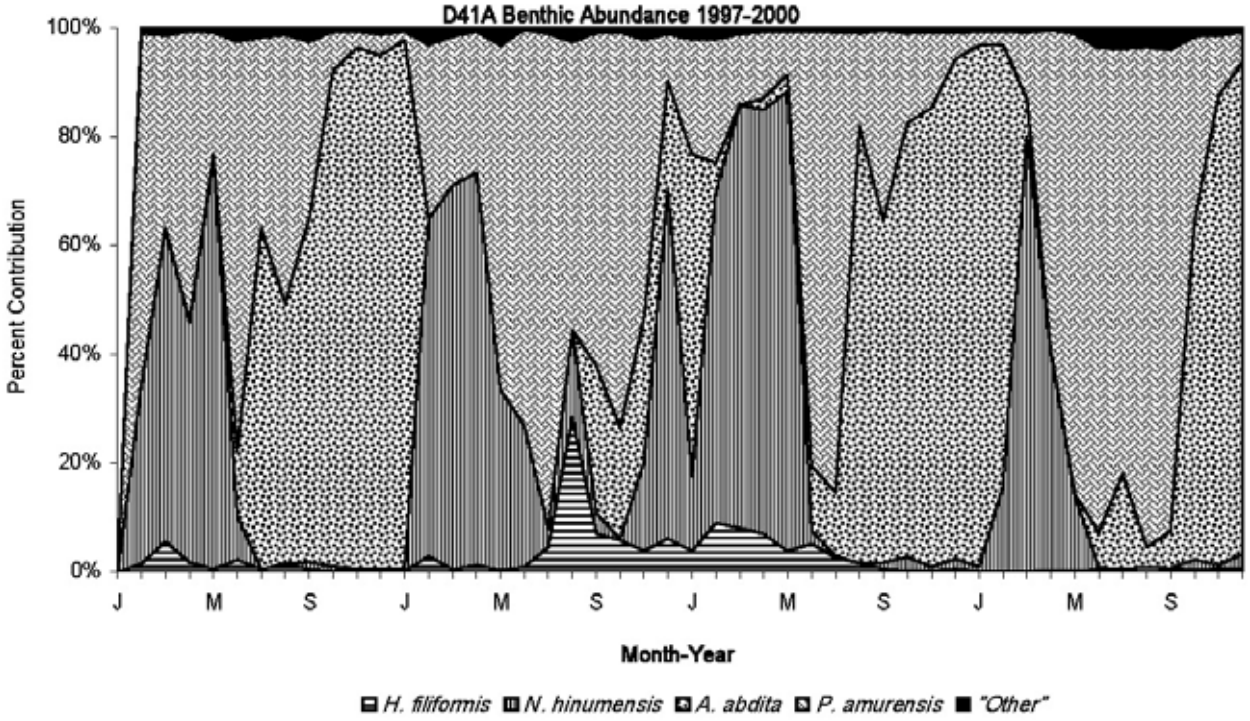


Figure 6-7 Percent abundance of macrobenthos at Stations D41 and D41A, 1997-2000

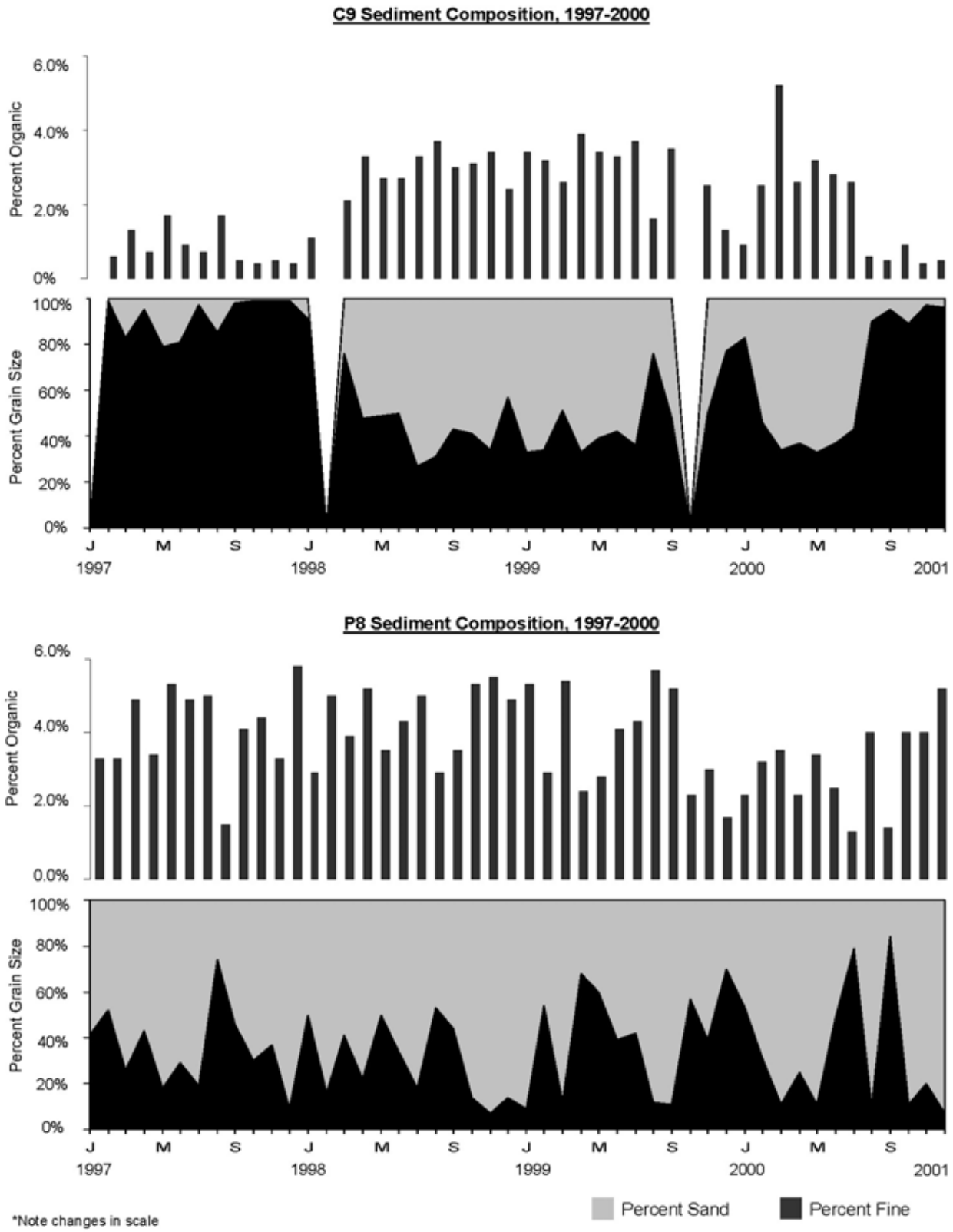


Figure 6-8 Sediment composition at sampling Stations C9 and P8, 1997-2000

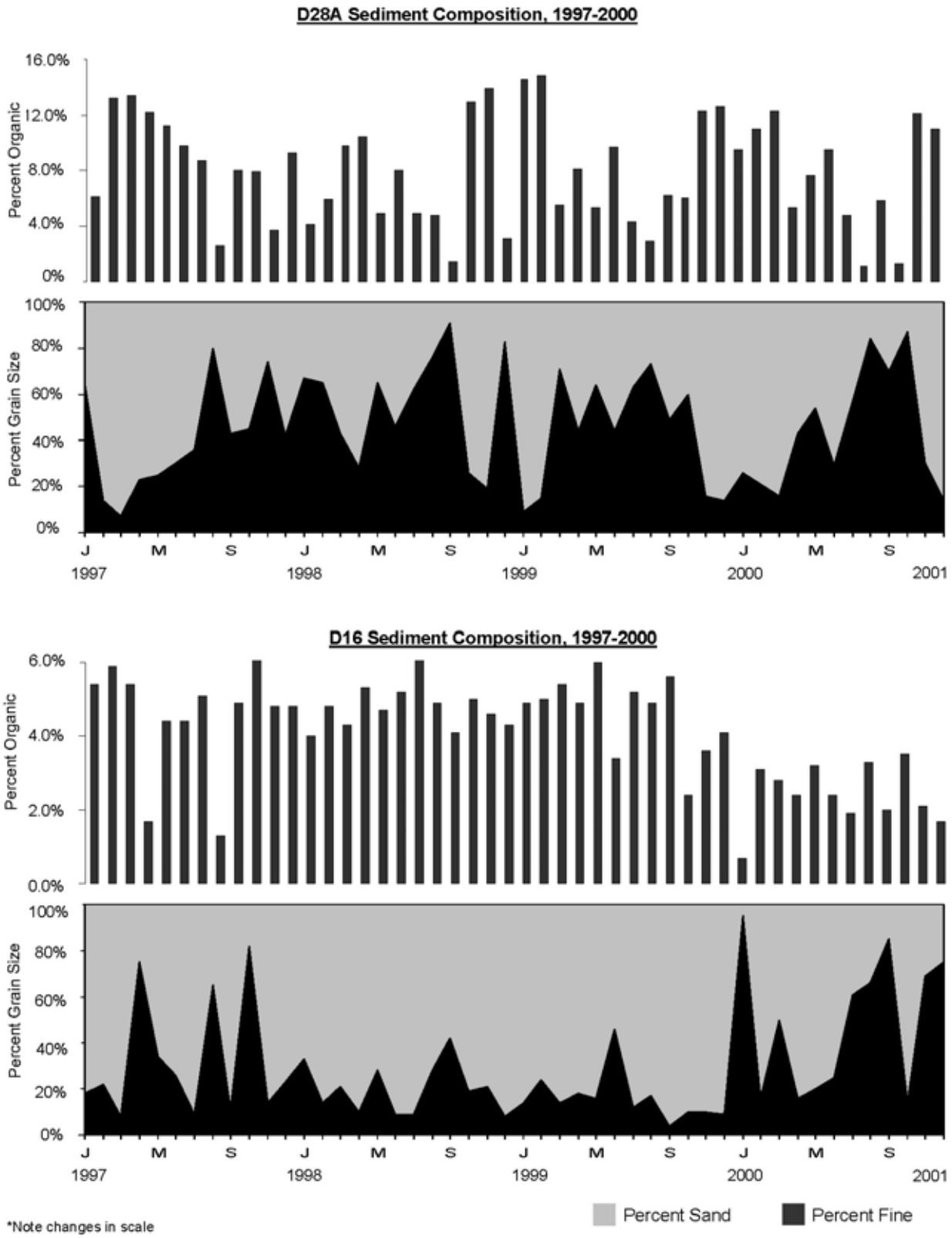


Figure 6-9 Sediment composition at sampling Stations D28A and D16, 1997-2000

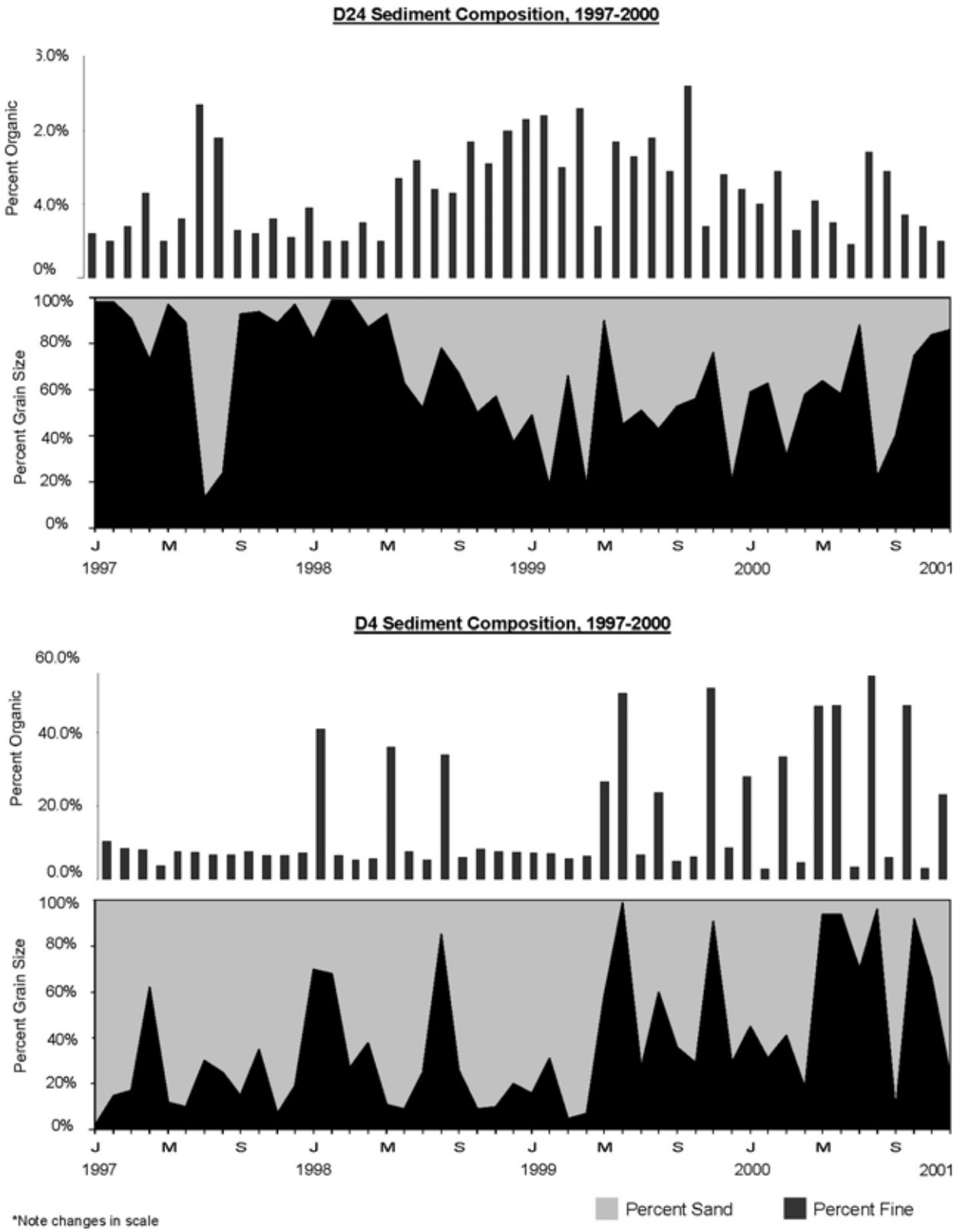


Figure 6-10 Sediment composition at sampling Stations D24 and D4, 1997-2000

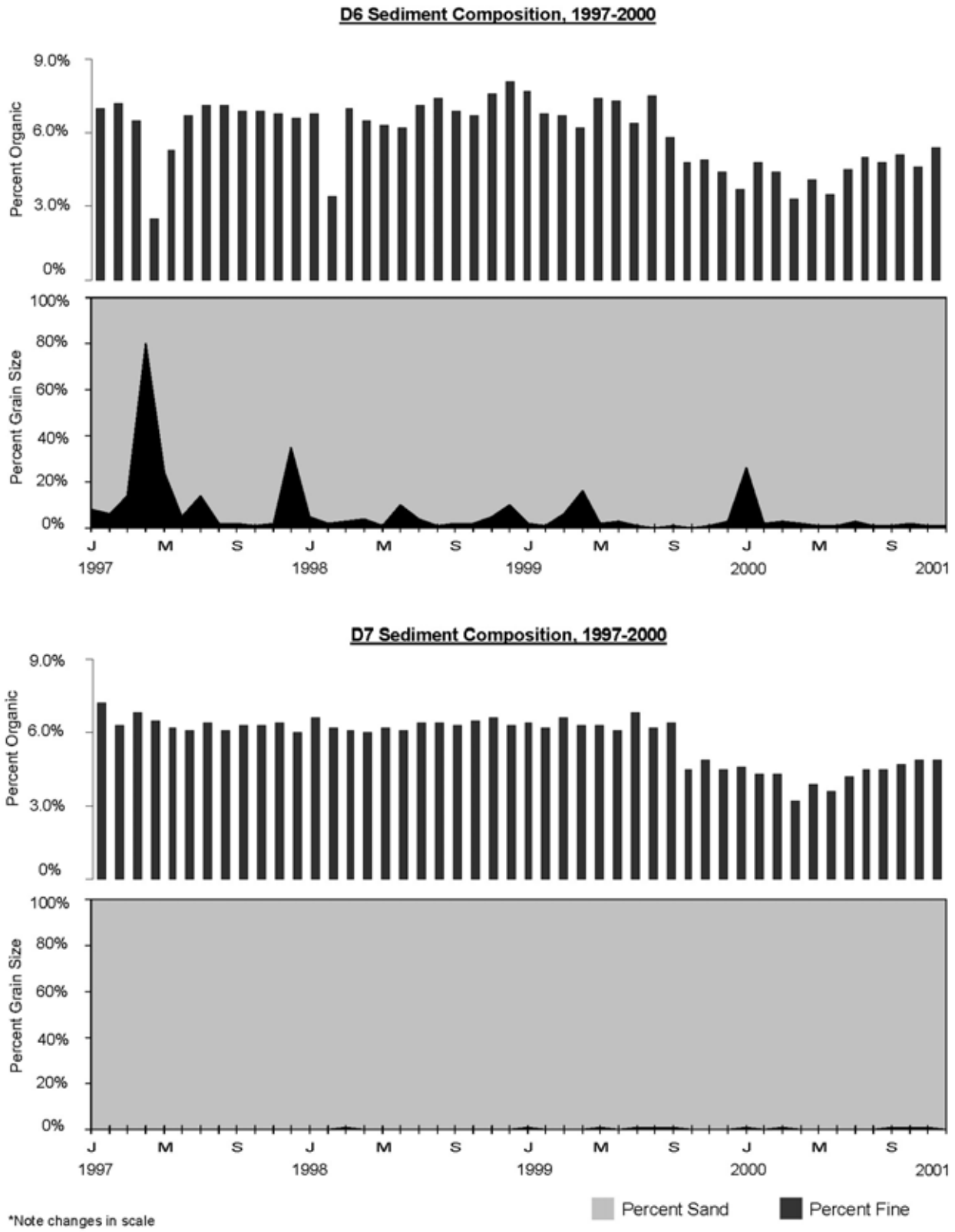


Figure 6-11 Sediment composition at sampling Stations D6 and D7, 1997-2000

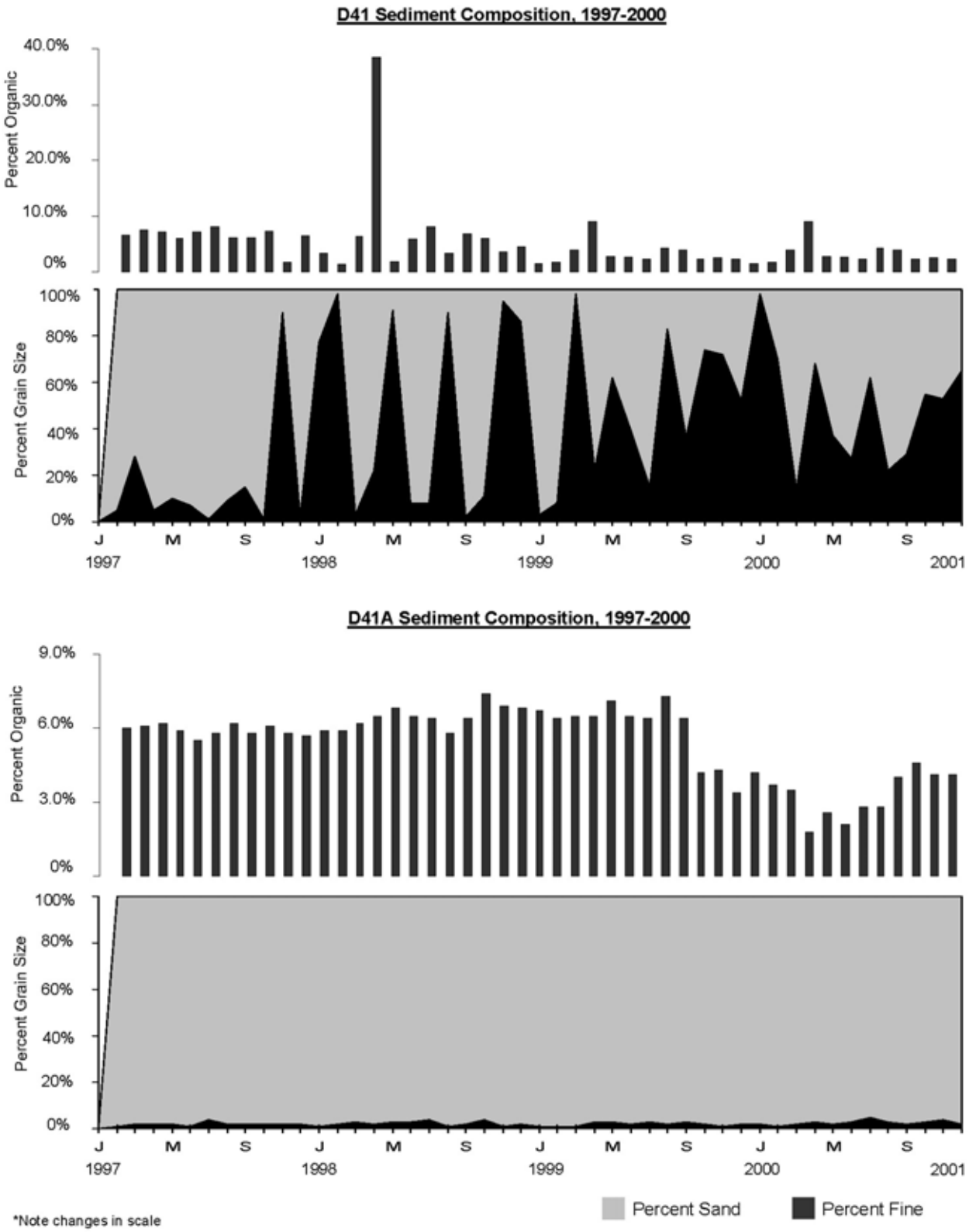


Figure 6-12 Sediment composition at sampling Stations D41 and D41A, 1997-2000